Watershed Watchdogs- Monitoring Coastal Bay Health through Bioinventory and Monitoring

Environmental Sciences, High School

Summary: Watershed Watchdogs involves students in hands-on, feet-wet biomonitoring and ecologic exploration activities. The program is a conglomerate of several independent but connected activities. This overview lesson plan is a compilation of all activities. Students collect shallow bay vertebrate and invertebrate organisms and kayak Sinepuxent bay. Teams identify organisms and record species population, size and sex on data sheets. Students also record environmental data using a variety of hand instruments such as hydrometers, turbidity tubes and pH kits. Students learn about plankton and microorganisms through laboratory work using microscopes and i.d. guides. Students record observations through field drawings and database entry.

Background:

The global climate is changing. The ocean is warming. A warming ocean affects the volume and the height of the sea due to thermal expansion and the melting of land-based ice. Climate scientists predict that the oceans around the mid-Atlantic coast will rise 1 meter by the year 2100. A rise of 1 meter will have a dramatic effect on our coastlines. A 1 meter increase will flood many of the world's largest cities and result in the loss of two-thirds of the coastal wetlands in the United States

Salt marshes are wetland ecosystems found along an open coastline or within an estuary. The mass of plants and animals (biomass) that is produced naturally on an acre of salt marsh is greater than what is produced on fertilized farmland. Wetlands have a rich food supply that supports many species and add greatly to global biodiversity. Wetlands provide such a safe place for the young animals that they are called the nurseries of the sea. The thick plant growth in wetlands traps sediments, filters out pollutants, and controls flooding. The plants in wetlands that grow above the surface of the water take up carbon dioxide (CO_2) from the air and release oxygen.

Organisms need specific conditions to thrive or survive. Scientists predict these conditions will be altered as the climate changes. In a salt marsh, there is a delicate balance between salinity, dissolved oxygen, turbidity and temperature. A change in any of these factors may affect the health and survival of the organisms living in the marshes.

A loss of salt marsh will also cause a loss in local economies. A large number of fish species and shellfish depend on salt marshes for food and shelter during some part of their life. As populations of these commercial fisheries diminish, so will the jobs and industry.

To protect our salt marshes and other wetlands, we must recognize their importance, understand how our actions affect these areas and develop ways to minimize the loss and disruption of these critical habitats.

Enduring Understandings

Scientists must use many indicators to assess the health of bay habitat.
Scientists use a variety of tools and procedures to gather and to share data.
Human activities in the local watershed can impact the health of the greater watershed.
Children and adults can take action to improve water quality.

Essential Questions

Is nekton and plankton community structure (species composition, abundance, and size structure) changing over time (e.g., decades)?
How do salt marsh communities change in response to storms, sea level rise and global warming?
How healthy IS the local watershed?
How can you be a good steward of the environment?

Vocabulary:
Barrier Island- coastal formation that separates open ocean from the mainland by an estuary or lagoon.
Zoo and phytoplankton- passive or week swimming organisms suspended in a water column.
Nekton- actively swimming aquatic organisms able to move independently of water currents.
Watershed- an area of land where surface water from rain and melting snow or ice converges to a single point, usually the exit of the basin, where the waters join another waterbody, such as a river, lake, reservoir, estuary, wetland, sea, or ocean.
Estuary- semi-enclosed coastal bodies of water that have free connection with the open sea and within which sea water mixes with fresh water.
Trophic level- position of species in the food chain.
Autotroph- organism that produces its own food (photosynthesis, chemical synthesis).
Heterotroph- Organism that get energy by consuming other organism.
Abiotic- non-living components in an ecosystem (water, air, rocks, heat, sun).
Biotic- living parts of an ecosystem (bacteria, plants, animals).
Turbidity- Amount of suspended particles in water.
Salinity- total amount of dissolved ions present in sea water.
Inventory and monitoring- Inventory the natural resources to determine their nature and status and monitor park ecosystems to better understand their dynamic nature and condition and to provide reference points for comparisons with other, altered environments.
Bioindicator species- a sensitive species in a region that acts as an early warning to monitoring biologists.
Arthropoda- Phylum of invertebrate animals with jointed legs and segmented bodies (crabs, shrimp, lobsters).
Crustacean- Class within Arthropda phylum with all members being decapods (5 pairs of legs) and a carapace of chitin.

Materials:

***Bay sampling activity*:** 5 seine nets, 15 hand nets, 5 observation tanks, 5 field i.d sheets, calipers, crab tongs, 5 small clear containers for shrimp, 5 larger containers for jellies.

***Water quality testing activity*:** 5 clipboards with 5 thermometers, compasses, anemometers, hydrometers china markers. Two turbidity tubes, LaMotte kits or Lab Quest H2O test kits/probes.

Plankton Lab: ASIS water sample, washable markers, projector camera, microscope, slides, coverslips, protoslo, plankto i.d. sheets, pipettes, blank paper.

Essential Standards and Clarifying Objectives

The student will demonstrate ways of thinking and acting inherent in the practice of science. The student will use the language and instruments of science to collect, organize, interpret, calculate, and communicate information.
EXPECTATION
1.1 The student will explain why curiosity, honesty, openness, and skepticism are highly regarded in science.
INDICATOR
- 1.1.-1.5

EXPECTATION
1.2 The student will pose scientific questions and suggest investigative approaches to provide answers to questions.
INDICATOR
- 1.2.1 ,1.2.5 ,1.2.6 ,1.2.7 ,1.2.8

EXPECTATION

1.3 The student will carry out scientific investigations effectively and employ the instruments, systems of measurement, and materials of science appropriately.
INDICATOR
- 1.3.1 ,1.3.4.

EXPECTATION
1.4 The student will demonstrate that data analysis is a vital aspect of the process of scientific inquiry and communication.
INDICATOR
- 1.4.1 ,1.4.2 ,1.4.6 ,1.4.7 ,1.4.9

EXPECTATION
1.5 The student will use appropriate methods for communicating in writing and orally the processes and results of scientific investigation.
INDICATOR
- 1.5.1 -1.5.5, 1.5.7, 1.5.8, 1.5.9

1.6 The student will use mathematical processes.
INDICATOR
- 1.6.1 ,1.6.5

EXPECTATION
1.7 The student will show that connections exist both within the various fields of science and among science and other disciplines including mathematics, social studies, language arts, fine arts, and technology.
INDICATOR
- 1.7.1 ,1.7.4 ,1.7.5 ,1.7.6

Goal 6: Environmental Science
The student will demonstrate the ability to use the scientific skills and processes (Core Learning Goal 1) and major environmental science concepts to understand interrelationships of the natural world and to analyze environmental issues and their solutions.
EXPECTATION
6.1 The student will explain how matter and energy move through the biosphere (lithosphere, hydrosphere, atmosphere and organisms).
INDICATOR
- 6.1.1 , 6.1.2

EXPECTATION
6.2 The student will investigate the interdependence of organisms within their biotic environment.
INDICATOR
- 6.2.1 , 6.2.2 ,6.2.3 , 6.2.4

EXPECTATION
6.3 The student will analyze the relationships between humans and the earth's resources.
INDICATOR
- 6.3.1 ,6.3.2 ,6.3.3 ,6.3.4 ,6.3.5

Lesson objective(s):

Students will be able to:

- Understand purpose of **biologic and ecologic monitoring** and inventories
- Recognize factors that force changes in an environment
- **Hypothesize** responses and **adaptations** of various organisms to changes in their environment

- Define **Bioindicator Species**
- Design and create **Food Webs**
- Recognize role of **Plankton** in aquatic ecosystem
- Explain impacts of **water quality** on organisms
- List primary concerns related to **climate change**
- Foster a sense of place and personal connections that leads to **stewardship**
- Understand what a **watershed** is, what their local watershed is and why it is unique
- Appreciate the importance of reliable data collection and the value of data analysis
- Enhance understanding that students are impacted by and have an impact on water quality, leading to real world applications and **civic responsibility**
- Have a hands on, positive and **FUN** experience outdoors!

Differentiation strategies to meet diverse learner needs:
Spatial: Map orientation at VC
Visual: Visitor Center exhibits/introduction
Interpersonal: Small group work teams; sharing responsibilities and achieving group goals
Intrapersonal: Sketching and drawing during field work and lab
Linguistic: Ranger orientation /instruction
Naturalistic: Hands on exploration of marsh/beach

ENGAGEMENT

Rangers will introduce program in visitor center while standing around large park map.
What is a watershed? (define coastal bay)
Ask students to share their past park experiences with group.
What did they do here?
Why do people come to the park?
How many students have never been here?
What is the park protecting?
Can the students find their house/school/neighborhood on the map?
Are they in the Coastal Bay Watershed?
What is function of barrier island?

Rangers will review the day's activities and schedule. Rangers will review purpose of biomonitoring and water quality monitoring. Rangers will explain in detail expectations and intentions and request student's assistance and involvement.

Students are asked to consider the impacts of water pollution and sea level rise and how it may affect their home and community.

EXPLORATION

Students will work in small teams to collect shrimp and comb jellies from dock pilings using hand nets, catch fish with seine nets and collect zooplankton with a plankton tow. Specimens will be identified, counted, viewed and released unharmed.

Students will kayak around tidal gut and learn about salt marsh ecology

Students will collect waters and environmental parameters using meteorological and hydrologic testing equipment

Students will use microscopes to view zoo and phytoplankton microorganisms

EXPLANATION

Students are tasked with collecting and recording data throughout the day. At the conclusion of the seine netting activity, student teams will be asked to review their discoveries.
What was the most populous organism?
What was water quality reading? What does this tell us?
How do the abiotic factors affect the biotic?
How might the tides affect the biotic and abiotic components? Why?

During plankton lab, students are asked to draw several of the organisms they find under the lens. Students are asked to describe how they move, identify any special features or characteristics.
What are their adaptations?
How does plankton fit into the energy flow and nutrient cycling?
What benefits or issues does plankton present?

ELABORATION

Students enhance their understanding of food webs, energy flow, predator prey relationships and interdependencies through the in-depth study of vertebrate and invertebrate coastal bay organisms.

Students improve their knowledge of watershed dynamics and hydrology through water quality testing and data analysis. Students enter their data into an on-line database for future comparisons and use.

Students recognize their personal role and stake in water quality. Students are able to connect the dots between human activities and water quality issues and are able to make several suggestions for pollution and impact reduction.

EVALUATION

Students will take a pre and post assessment test. Student photographs and sketches will be uploaded to park Flickr page and student data will be posted to Hands on the Land webpage.

Resource list:

www.nps.gov/asis/forteachers

www.handsontheland.org

www.bridgingthewatershed.org

http://www.teachoceanscience.net/teaching_resources/education_modules/barrier_islands_and_sea_level_rise/get_started/

http://mddnr.chesapeakebay.net/eyesonthebay/index.cfm

http://www.waterontheweb.org/under/waterquality.html

http://www2.vims.edu/bridge/search/bridge1output_menu.cfm?q=plankton

Materials
Microscope: http://www.celestron.com/science_education/microscopes.html

Nets: http://www.brunsonnet.com/index.cfm?fuseaction=category.display&category_id=71

Water quality test kits:
http://www.lamotte.com/environmental_education_monitoring/product_line/water_monitoring_kits.html

http://www.vernier.com/products/packages/water-quality/labq2/

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Name: _____ Date: _____

1. What is one thing that makes barrier islands unique?

2. What is one thing that makes salt marshes unique?

3. Name three ways people use the coastal bays.

4. Describe the energy flow pyramid.

5. Describe a four-member coastal bay food chain.

6. What are two primary producers in bay food webs?

7. Name two top consumers in the bay food web.

8. What happens to the amount of available light as turbidity increases?

9. How does water temperature affect dissolved oxygen?

10. List 3 major environmental issues in the local watershed.

11. Describe two tests or indicators that help determine the health of coastal bays.